

Incidence, Etiology, and Patterns of Maxillofacial Fractures in Ain-Shams University, Cairo, Egypt: A 4-Year Retrospective Study

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Craniomaxillofac Trauma Reconstruction 2014;7:224–232

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Abstract

Keywords

- ▶ maxillofacial trauma
- ▶ maxillofacial fractures incidence
- ▶ mandibular fractures
- ▶ facial fractures patterns
- ▶ maxillofacial fractures

Although there is a worldwide increase in maxillofacial trauma incidence; the pattern and etiology of these injuries varies from one country to another depending on socioeconomic, cultural, and environmental factors. This study aims to realize the epidemiological characteristics of maxillofacial fractures in our department. A retrospective cross-sectional study of all facial trauma patients admitted to our department during 2009 to 2012. Patients' data including gender, age, etiology of trauma, the pattern and demographic distribution of fractures of maxillofacial skeleton, and associated injuries were analyzed and compared with previously published data. The chi-square test was used with a *p* value of less than 0.05, which was considered statistically significant. There is a significant increase in maxillofacial fractures incidence in the past 2 years than former ones. There is a male predominance with highest incidence in the age group of 20 to 40 years. Road traffic accident is the most common etiological factor followed by violence. There is increase in mandibular fracture incidence compared with midface. The significant increased incidence of maxillofacial fracture due to motor car accidents and assaults in the past 2 years reflects a behavioral change within the community.

Facial fractures are the result of various types of trauma to the face, and may occur in isolation or combined with other injuries.¹ The epidemiological assessment of maxillofacial fractures represents a special interest to identify the potential trend of their frequency, age, gender, and anatomic distribution especially when comparison of these patterns is done over time periods.

The incidence of maxillofacial fractures varies widely between different countries depending on local demographic and socioeconomic status.^{2,3} Generally, the incidence is higher in males than in females with peak incidence between 20 and 30 years.⁴ Many causes had been incriminated in the etiology of facial fractures; however, the main causes worldwide are traffic accidents, assaults, falls, and sport injuries.^{5,6} Motor car accidents (MCA) have always been the most

frequent cause of facial fractures worldwide; however, recent studies have shown that assaults are now the most common cause in many developed countries.

Our hospital is serving more than 4 million people living in the eastern region of Cairo besides draining areas of the country side near this region. The presence of our plastic surgery department with surgeons specializing in maxillofacial surgery and the lack of public hospitals specializing in this field in the surrounding region has led it to act as a tertiary care center and have increased the number of injuries likely to be referred and treated in this hospital, thus offers a model that could be a sign of our community.

In this article, we intend to assess the epidemiological features of maxillofacial fractures treated at our department for the period from January 2009 to December 2012.

received

August 5, 2013

accepted after revision

August 7, 2013

published online

May 21, 2014

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Tel: +1(212) 584-4662.

DOI <http://dx.doi.org/10.1055/s-0034-1374061>.
ISSN 1943-3875.

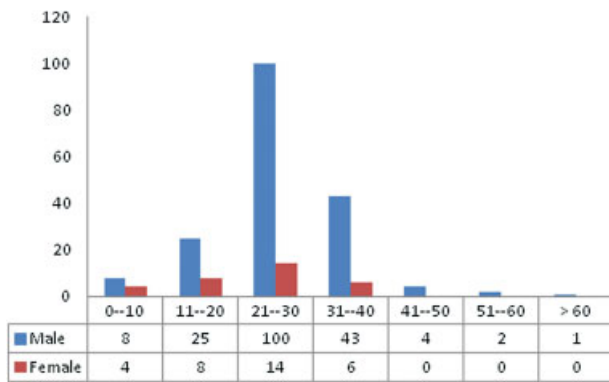


Figure 1 Age and gender distribution of patients.

Patients and Methods

A total of 330 patients suffering from facial trauma and suspected facial bone fractures including the nose, frontal bone, maxilla, zygoma, and mandible were presented to the emergency room in our hospital in the period between 2009 and 2012. Of these, only 215 patients were confirmed to have facial fractures necessitating surgical intervention by computed tomography (axial and coronal slices + three-dimensional reconstructed images) and so admitted to our department and operated upon.

We retrospectively analyzed their medical records and data were collected concerning sex, age, cause of injury, type of fracture, treatment modality, and postoperative complications. Patients were divided into seven age groups: 0 to 10-year-old, 11 to 20-year-old, 21 to 30-year-old, 31 to 40-year-old, 41 to 50-year-old, 51 to 60-year-old, and > 60-year-old groups. The following analyses were conducted for each age group: causes of injury (e.g., motor vehicle accidents, falling, violence, and gunshot) and fracture type (e.g., nasal bone, zygoma, maxilla, mandible, and frontal bone fractures) and clinical outcomes.

Statistical Analysis

Patient characteristics were analyzed using descriptive statistics; qualitative variables (absolute and relative frequencies) and quantitative variables (means and standard deviation [SD]). The chi-square test was used to evaluate the association between gender, cause of facial fractures, and

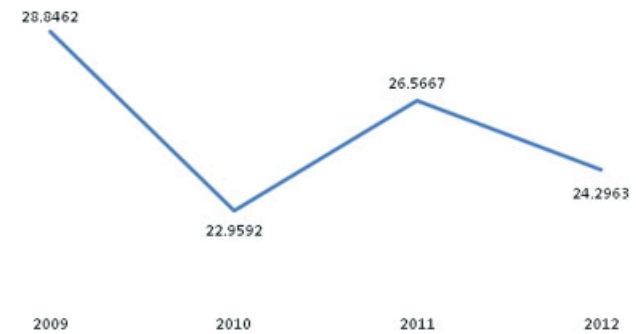


Figure 2 Mean age distribution of patients.

region affected. A *p* value of less than 0.05 was considered statistically significant.

Results

Patients' Data

A total of 215 patients were evaluated for the study in which 183 were males and 32 were females. There was a vast male predominance in all age groups with an overall male-to-female ratio of 5.7:1. The age group 21 to 30 years accounted largest in both sexes (in males and in females) followed by patients in the age group 31 to 40 years (►Fig. 1).

The annual distribution of patients based on the number and gender of patients is shown in ►Table 1. There was no statistical difference among the individual years.

The age of the patients ranged from 2 to 62 years with a mean age 25.7256 years (SD, 9.16842 years). The highest mean was in 2009 (28.8462) whereas the least was in 2010 (22.9592) with no statistical difference between the 4 years of study (►Fig. 2).

Among these, the third and fourth decade age groups were significantly more likely to sustain facial fractures (75.3%) with a peak incidence of maxillofacial trauma observed at 25 years ($p < 0.05$). A decreasing trend was seen with age proceeding to both the extremes (►Fig. 3).

Trauma Type

The most common cause of injury throughout the study was violence and MCA, followed by gunshot and fall from height. The mean age of the patients involved in violence was 27.6364 years (SD, 6.94176 years), whereas the mean age

Table 1 Annual distribution of fractures based on gender difference

			Year				Total
			2009	2010	2011	2012	
Sex	Male	Count	43	41	52	47	183
		% within year	82.7	83.7	86.7	87.0	85.1
	Female	Count	9	8	8	7	32
		% within year	17.3	16.3	13.3	13.0	14.9
Total		Count	52	49	60	54	215
		% within year	100.0	100.0	100.0	100.0	100.0

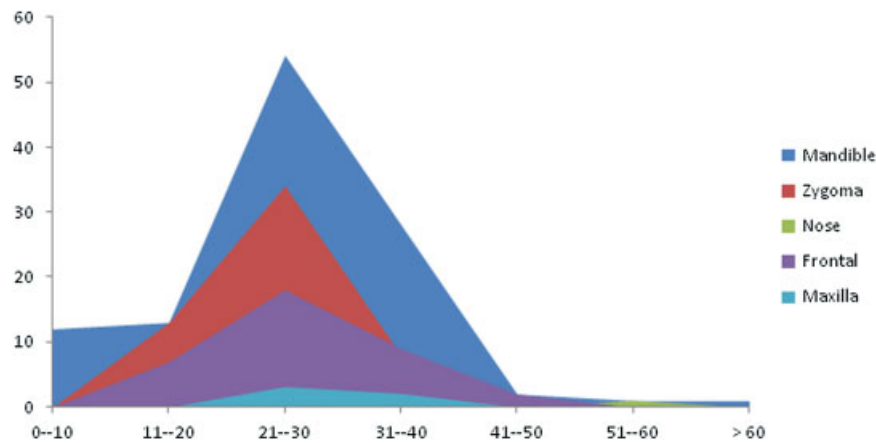


Figure 3 Fracture site distribution based on age group.

of those who were not involved in violence was 20.5866 years (►Table 2).

The annual distribution of patients based on cause of injury showed that MCA was statistically significantly higher in 2009 and 2010 ($p < 0.05$); however, a shift occurred in 2011 and 2012 leading to statistically significant increase in the rate of violence than the other causes of injury in the previous 2 years ($p < 0.05$) as shown in ►Fig. 4.

Almost all patients involved in gunshot injuries and approximately 85% of the patients involved in violence and MCA were males (►Fig. 5).

In all the age groups, violence and MCA constituted the main causes of fractures with a significant higher difference than other causes ($p < 0.05$). In patients younger than 10 years, the fractures were mostly due to fall from height.

Falling was a common cause of injury in children younger than 15 years. Violence was more common in those older than 27 years whereas firearms were common in those older than 26 years (►Table 3).

Pattern and Site of Fracture

There were 179 (83.2%) simple facial fractures and 36 (16.7%) multiple facial fractures. Significantly, mandibular fractures were the most common among all facial bone fractures, accounting for 51.6% of all fractures ($p < 0.05$), zygomatico-maxillary fractures (25.6%) and nasal fractures (16.7%) were the next most common (►Fig. 6).

In all age groups, fractures of the mandible and zygoma constituted the foremost locations of fractures with a signifi-

cant higher difference than other locations ($p < 0.05$) (►Table 4).

The site of fracture distribution based on gender differences showed that fractures were mainly affecting the mandible and zygoma with higher percentage of mandible and nasal bone affection within the male sex group than within the female sex group but with no significant statistical difference (►Table 5).

Fracture mandible showed significantly statistical higher incidence than other sites based on the cause of injury ($p < 0.05$) except for the MCA where fracture zygoma was higher but with no statistical difference (►Fig. 7).

The annual distribution of patients based on the site of fracture is shown in ►Table 6. There was no statistical difference among the individual years.

Treatment Modalities

Surgical treatment was performed on the majority of the patients throughout the 4 years. A total of 215 operations were done with open reduction and internal fixation showed the higher frequency (90.7%) with no significant statistical difference among the individual years. The annual distribution of procedures done for the patients is shown in ►Table 7. There was no statistical difference among the individual years.

The procedure distribution of patients based on age is shown in ►Table 8. There was no statistical difference among the different age groups.

Over 90% of patients involved in gunshot injuries, violence, and MCA necessitated open reduction and internal fixation,

Table 2 Cause of fracture distribution of patients

	Number	Percent	Mean age	Std. deviation
Fall from height	17	7.9	15.4118	15.28913
Gunshot	22	10.2	25.9091	4.95608
Violence	88	40.9	27.6364	6.94176
Motor car accident	88	40.9	25.7614	9.22888
Total	215	100.0	25.7256	9.16842



Figure 4 Cause of fracture distribution based on year.



Figure 5 Cause of fracture distribution based on gender.

Table 3 Cause of fracture distribution based on age group

ALL	Fall	Violence	MCA	Firearms
0–10	10	0	2	0
11–20	3	14	16	3
21–30	2	46	47	17
31–40	1	26	19	2
41–50	0	2	2	0
51–60	0	0	2	0
60	1	0	0	0
Total	17	88	88	22

Abbreviation: MCA, motor car accidents.

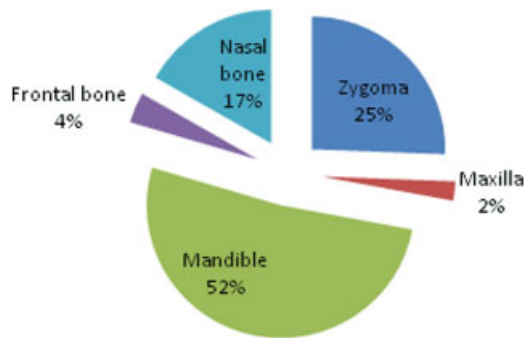


Figure 6 Site of facial fractures distribution in patients.

whereas patients involved in falls were treated almost equally by open reduction and internal fixation and mandibulomaxillary fixation (►Fig. 8).

All zygomaticomaxillary complex, frontal bone, and 89.2% of mandibular fractures needed open reduction and internal fixation, whereas all nasal bone fractures were treated only with splinting (►Fig. 9).

Postsurgical Complications

The postoperative complications included infection, paresthesia, diplopia, ectropion, and malocclusion (►Table 9).

Discussion

Many studies all over the world had been conducted to study the epidemiology and characteristics of maxillofacial trauma in a single medical center^{7–12}; however, there are very few studies regarding the Egyptian population.¹³

This study was done to review the different epidemiological features of maxillofacial fractures as the incidence, cause, and site of fracture and patients' data as age, sex, and also surgical procedures and postoperative complications and to correlate these different features with each other within the years of study.

In this study, an overall male-to-female ratio was observed as 5.7:1, this is similar to findings from other studies^{12,14} and higher than other studies.^{15–17} This male dominance reflects cultural and/or employment differences in our eastern community and express the probability of exposure of male to

Table 4 Site of fracture distribution based on age group

ALL	Mandible	Zygoma	Nose	Frontal	Maxilla
0–10	12	0	0	0	0
11–20	13	13	1	7	0
21–30	54	34	3	18	3
31–40	28	8	3	9	2
41–50	2	0	0	2	0
51–60	1	0	1	0	0
60	1	0	0	0	0
Total	111	55	8	36	5

Table 5 Site of fracture distribution based on gender

			Sex		Total	
			Male	Female		
Affected part	Zygoma	Count	46	9	55	
		% within sex	25.1	28.1	25.6	
	Maxilla	Count	4	1	5	
		% within sex	2.2	3.1	2.3	
	Mandible	Count	95	16	111	
		% within sex	51.9	50.0	51.6	
	Nasal bone	Count	6	2	8	
		% within sex	3.3	6.3	3.7	
	Frontal bone	Count	32	4	36	
		% within sex	17.5	12.5	16.7	
	Total		Count	183	32	215
			% within sex	100.0	100.0	100.0

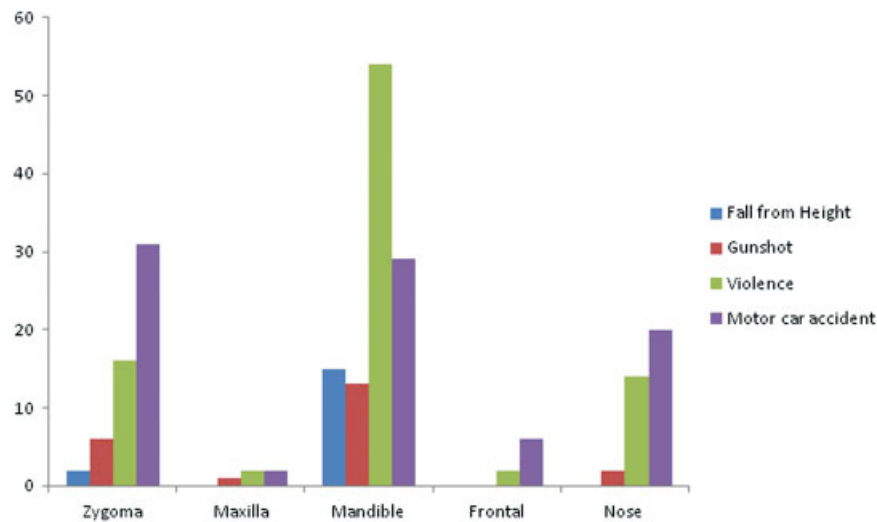


Figure 7 Site of fracture distribution based on cause of fracture.

Table 6 Site of fracture distribution of fractures based on year

			Year				Total
			2009	2010	2011	2012	
Affected part	Zygoma	Count	15	15	9	16	55
		% within year	28.8	30.6	15.0	29.6	25.6
	Maxilla	Count	3	0	2	0	5
		% within year	5.8	0	3.3	0	2.3
	Mandible	Count	23	19	40	29	111
		% within year	44.2	38.8	66.7	53.7	51.6
	Frontal bone	Count	5	2	0	1	8
		% within year	9.6	4.1	0	1.9	3.7%
	Nasal bone	Count	6	13	9	8	36
		% within year	11.5	26.5	15.0	14.8	16.7
Total		Count	52	49	60	54	215
		% within year	100.0	100.0	100.0	100.0	100.0

Table 7 Procedure distribution of fractures based on year

			Year				Total
			2009	2010	2011	2012	
Procedure	MMF	Count	3	5	2	2	12
		% within year	5.8	10.2	3.3	3.7	5.6
	ORIF	Count	44	42	58	51	195
		% within year	84.6	85.7	96.7	94.4	90.7
	Splinting	Count	5	2	0	1	8
		% within year	9.6	4.1	0	1.9	3.7
Total		Count	52	49	60	54	215
		% within year	100.0	100.0	100.0	100.0	100.0

Abbreviations: MMF, mandibulomaxillary fixation; ORIF, open reduction internal fixation.

Table 8 Procedure distribution based on age group

ALL	Number	Splinting	MMF	ORIF
0–10	12	0	12	0
11–20	34	1	0	33
21–30	112	3	0	109
31–40	50	3	0	47
41–50	4	0	0	4
51–60	2	1	0	1
60	1	0	0	1
Total	215	8	12	195

Abbreviations: MMF, mandibulomaxillary fixation; ORIF, open reduction internal fixation.

high risk jobs and outdoor daily life risks that could lead to facial injuries.

In agreement with many other studies,^{18–20} the third and fourth decade groups of age in both sexes with mean age of 25.7 years were significantly more likely to sustain facial fractures. That is because it is the energetic period of life where an individual takes part in hazardous sports, fast driving, and more likely to be involved in violence acts. In all age groups, violence and MCA constituted the main causes of fractures in concordance with other studies.^{21,22} The

maxillofacial fracture in the patient over 60 years was due to fall and this matches with other studies stating that falls are the main cause of facial injury in elderly patients.²³

As most of the studies stated, the etiology of injuries varied considerably between countries as regard to the socioeconomic status.^{2,3} The main causes of maxillofacial fractures all over the world are road accidents, assaults, fall, and sports-related injuries.^{5,6} In our study, the percentage of maxillofacial fractures due to MCA in 2009 and 2010 were 65.4 and 73.5%, respectively, and constituted the main cause of injury.

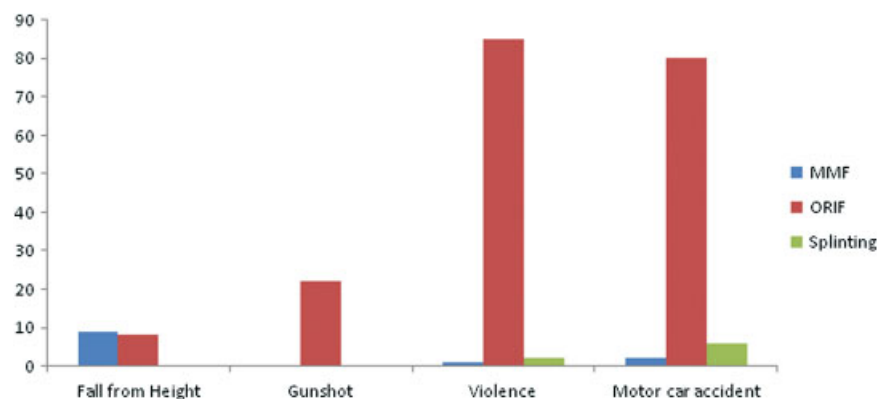
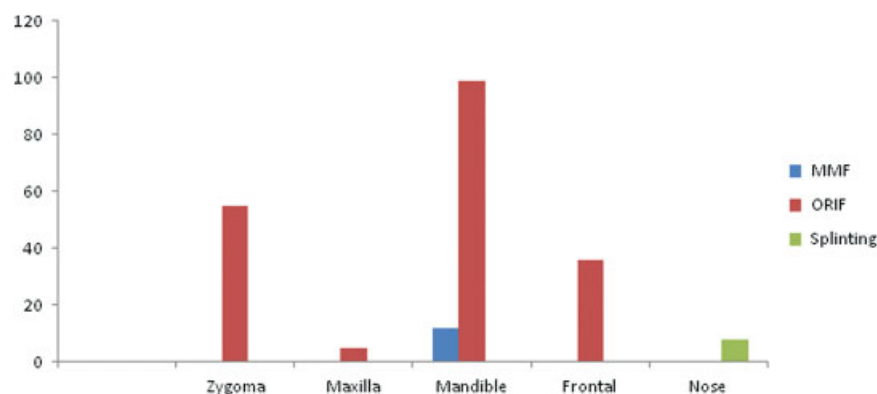
**Figure 8** Procedure distribution based on cause of fracture.**Figure 9** Procedure distribution based on site of fracture.

Table 9 Postoperative complications

Complication	Number of patients
Infection	7
Malocclusion	5
Diplopia	3
Ectropion	2
Paresthesia	3
Total	20

These findings are in agreement with other studies from developing countries.^{24,25} This increase is not in concordance with regular and frequent stress on the use of seat belts and helmets, in addition to many new well-constructed highways with regular maintenance. We think that this is because of a behavioral deficit of some individuals showing ignorance of traffic rules and regulations.

However, this had significantly decreased in comparison to 2011 and 2012 (16.7 and 14.8%, respectively) with a great increase in the frequency of interpersonal violence accounting for more than 55% of the injuries. This is similar to findings from other studies.^{26,27}

Violence was significantly more common in males than in females (5.8:1) as results from other studies,¹⁶ and also the rate of incidence was much higher in those older than 27 years than all other age groups which was also similar to other studies.³

The significant increase in the usage of firearms in the past 2 years of the study reflects a change in some cultural habits and necessitates the implication of new preventive measures to control this increase that pose unexpected consequences.

In our study, mandibular fractures were the most common among all other sites accounting for 51.6% of all fractures as mentioned in many other studies^{12,14}; however, this is not corresponding with other studies that found that nasal bones and zygomaticomaxillary complex the most common site of injury due to their prominent position within the facial skeleton.^{10,28}

Concerning the site of fracture in relation to cause of injury, mandibular fractures were likely to occur with violence and this agrees with the common thought that assaults are significant predictors for isolated mandible fractures.¹ On the contrary, all other sites were more likely in MCA.

Because of the high variability in the maxillofacial fracture patterns; many treatment modalities have been proposed depending on the own features of each fracture and also surgeons' experience and that is why standardization of a surgical technique is not possible and combination of different methods are preferred.

In our study, open reduction and internal fixation with titanium plates was the most commonly used method with the usage of bone grafts in old fractures only while mandibulomaxillary fixation alone and splinting were used in less than 10% of cases.

The most frequent postoperative complications after treatment of maxillofacial fractures are malocclusion, infection, and nonunion.²⁹ We had a complication rate of 9.3% ($n = 20$);

the most common complication was infection (35%) treated conservatively with broad spectrum antibiotics and also local wound care. Malocclusion took place in five patients; all of them needed a second surgery.

The significant increased incidence of maxillofacial fracture due to MCA and assaults in the past 2 years reflects a behavioral change within the community and showed the necessity for a national plan that should be headed to prevention and treatment.

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